COLSF 8.1 V1

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Job Number: 124-01.39
Job Title: Colbert Landfill
Location: Spokane, Washington

Date: December 21, 1990

To: Mr. Neil Thompson
U.S. EPA
1200 Sixth Avenue
Seattle, WA 98104

We are sending herewith:

Copies	Description
1	Suggested Sampling Frequency for Colbert Landfill Domestic Well Sampling Program.

- [X] For Your Review/Information
- [ ] For Approval
- [ ] Approved as Noted
- [ ] Returned for Corrections as Noted; Please Resubmit
- [ ] For Your File
- [ ] Take Appropriate Action

Remarks: Forwarded at the request of Dean Fowler, Spokane County.

LANDAU ASSOCIATES, INC.

By: Lawrence D. Beard, P.E.

LDB/jfs

Memorandum

TO: Dean Fowler
Spokane County Utilities Department

FROM: Lawrence D. Beard, P.E. LB
Landau Associates, Inc.

RE: **SUGGESTED SAMPLING FREQUENCY FOR THE COLBERT LANDFILL DOMESTIC WELL SAMPLING PROGRAM**

DATE: December 14, 1990

INTRODUCTION

Landau Associates, Inc. has developed suggested sampling frequency criteria for the Colbert Landfill Domestic Well Monitoring Program (Program) at your request. These suggested criteria are based on Landau Associates' knowledge of geohydrologic conditions and contaminant distribution at the site, including evaluation of chemical data from the Program. We understand that the primary purpose of the Program is to identify domestic wells that meet the criteria for connection to an alternative water supply. As described in Section VIII of the Colbert Landfill Consent Decree, a residence must be connected to an alternative water supply by the County if the well was in use prior to entry of the Consent Decree (February 28, 1989) and one of the following conditions are met:

- One or more of the Constituents of Concern exceed the Performance Standards for two consecutive samplings
- The average annual concentration (based on 12 monthly samplings) of one or more of the Constituents of Concern exceeds 65 percent of the Table IV-1 Evaluation Criteria.

Exceedance of the Performance Standards requires prompt connection of a residence to an alternative water supply. Exceedance of the 65 percent level (65 percent of the Table IV-1 Evaluation Criteria) triggers additional sampling and evaluation over a 12 month period. If an exceedance of the Performance Standards occurs during monthly sampling (triggered by a 65 percent exceedance of the Evaluation Criteria), connection criteria based on a Performance Standard exceedance would predominate.

BACKGROUND

The Performance Standard concentrations are based on long term (chronic) exposure to the Constituents of Concern. As a minimum, domestic wells should be sampled with sufficient regularity to prevent chronic exposure. The time frame that constitutes chronic exposure varies depending on the constituent characteristics and the assumptions used for the risk assessment calculations. The exposure periods for development of the Performance Standard concentrations range between 7 and 70 years.

Based on 7 to 70 years constituting chronic exposure, a sampling frequency that limits potential exposure at Performance Standard concentrations to one year or less is an appropriate goal. Our sampling frequency recommendations are directed towards meeting or exceeding this goal.

Prior to discussing specific sample frequency criteria, it is important to understand some of the geohydrologic and contaminant transport considerations that impact development of a ground water sampling strategy. Determination of the rate of contaminant migration for a natural ground water flow system is usually a rough approximation. Even under the best of conditions, influences such as aquifer nonhomogeneity and anisotropy, seasonal fluctuations in the rate and direction of ground water flow, contaminant dispersion and partitioning, and ground water pumping can greatly influence the rate and direction of contaminant migration. Complex geohydrologic conditions, such as those present to the east of the Colbert Landfill, add to the inherent level of uncertainty present in contaminant transport estimates.

Although uncertainties exist, contaminant transport theory provides some useful guidance for ground water monitoring frequency. In general, dissolved contaminants will migrate much faster in the direction of ground water flow than transverse to the flow direction. Thus, sampling more frequently near the down gradient leading edge of the plume than along the sides of the plume is appropriate. Additionally, a contaminant plume that has migrated a significant distance from the source typically has a long leading edge of low concentration constituents, minimizing the probability that concentrations will change from nondetection (or low levels) to high concentrations in a short time period.

These contaminant transport concepts are useful in developing criteria for sampling frequency, but long term, site specific monitoring data often provide greater insight into contaminant migration characteristics than theoretical estimates. Over 7 years of domestic well chemical data are available for the Colbert Landfill area, and Landau Associates used these data during development of our suggested sampling frequency criteria.

SUGGESTED SAMPLING FREQUENCY CRITERIA

Table 1 presents the time periods between initial detection and exceedance of Performance Standards for domestic wells in the Program. Entries for Table 1 were limited to those wells where the Constituents of Concern were either not detected or were present in low concentrations for one (or more) of the early sampling events. Table 1 shows that more than one year separated initial detection and exceedance of the Performance Standards for all wells except the (b) (6) well, where exceedance occurred about 9 months following initial detection. Additionally, concentrations in the (b) (6) well decreased to slightly below the Performance Standards for a follow-up sampling to the exceedance event. These data support the use of a once per year sampling frequency for wells that do not presently contain Constituents of Concern in detectable concentrations.

Developing sampling frequency criteria for wells located in areas where constituent concentrations are above the detection limits and below 65 percent of the Table IV-1 Evaluation Criteria is not as straightforward. Factors that need to be considered include where the well is located in relation to the direction of ground water and contaminant migration, the relative proximity and constituent concentrations of other wells between the subject well and the main body of the plume, constituent concentrations for the most recent sampling of the well, and the rate of change in constituent concentrations based on previous sampling events.

Quarterly sampling is the most frequent sampling interval suggested for wells not subject to monthly sampling (due to exceedance of 65 percent of the Evaluation Criteria), and should be limited to wells with detectable constituent concentrations that meet one or more of the following criteria:

- Wells near the downgradient leading edge of the plume
- Wells located in areas where contaminants are not migrating in the direction of ground water flow, if nearby wells exhibit constituent concentrations that exceed the Performance Standards
- Wells for multiuser water systems such as the Wahoo and North Glen Water Districts, because their greater water usage may accelerate contaminant migration to the well.

Wells exhibiting detectable constituent concentrations that do not meet all of the criteria for quarterly sampling should be sampled annually or semiannually. Annual sampling (when contaminant concentrations are present) is appropriate for wells that meet all of the following conditions:

TABLE 1

COLBERT LANDFILL RD/RA
TIME FOR INITIAL DETECTION TO EXCEEDANCE OF PERFORMANCE STANDARDS FOR DOMESTIC WELLS[a]

Owner	Well Number[b]	Constituent First Detected (M/D/Y)	Performance Standard First Exceeded (M/D/Y)	Time Between First Detection and Exceedance (Months)
Rozell (Bower)[c]	1473D-3	9/6/85[d]	12/86	15+
(b) (6)	0273P-5	3/14/83[d]	5/17/89	74+
	1073E-1	10/25/88	(4/21/90)[e]	18+
(b) (6) South	0273P-3	8/7/85[d]	(5/18/90)[e]	57+
(b) (6)	1473M-1	8/8/88	(5/18/90)[e]	21+
	0273E-1	4/4/88	3/13/90	23
	0273L-2	6/8/83	(10/18/89)[e][f]	75+
(b) (6)	1573B-5	7/16/85	(6/20/90)[e]	59+
King Springs	0373P-1S	10/23/80[d]	3/6/83	29+
(b) (6)	0273E-3	11/20/87	8/8/88	9
Wahoo Water District	1073J-2	12/86	(5/18/90)[e]	41+

(a) Based on domestic well data collected through July 1990.

(b) Colbert Domestic Well Sampling Program Number.

(c) Previous owner.

(d) Constituent present at first sampling.

(e) Performance standards have not been exceeded, last test on date in parentheses.

(f) An exceedance of 1,1-DCE criteria occurred for the 8/17/87 sampling, but did not occur for subsequent samplings.

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- The well is located along the lateral (transverse to ground water flow) or upgradient plum boundary
- The well exhibits a long term history of low to moderate constituent concentrations
- Nearby wells do not exhibit constituent concentrations that exceed the Performance Standards.

We suggest that wells exhibiting detectable constituent concentrations that do not meet these criteria be sampled semiannually. The selection of semiannual or annual sampling for wells with detectable constituent concentrations should be determined on a well-by-well basis and reviewed annually.

As previously described, annual sampling is suggested for wells that do not presently contain Constituents of Concern in detectable concentrations. Additionally, it may be appropriate to reduce sampling for some nonimpacted wells to biannual, and to remove some nonimpacted wells from the Program entirely. Biannual sampling or deletion from the Program should be considered for wells that meet all of the following criteria:

- The well is located a significant distance up gradient or cross gradient from the plume
- Aquifer flow characteristics are well understood in the area of the well
- One or more wells participating in the Program are located between the subject well and the plume boundary.

We suggest that biannual sampling be used as a spacial and temporal transition frequency between annual sampling and elimination from the Program. Sampling frequency should progress from annual sampling to biannual sampling, and then to exclusion from the Program, as distance from the plume increases. Sampling frequency for wells within the Program that are identified for biannual sampling or elimination from the Program, should progress from annual to biannual sampling prior to removing the well from the Program.

Regardless of the sampling frequencies selected, it is probable that anomalous results will occasionally occur. We recommend that some discretionary samplings be reserved to address this eventuality. Although a specific number is difficult to define, 10 to 20 discretionary samples per annum should be adequate. The criteria that would trigger a discretionary sampling might vary, but the criteria proposed by the Sampling Committee (40 percent of the Table IV-1 Evaluation Criteria and a 25 percent increase in constituent concentration) is a reasonable guideline.

SUMMARY

To summarize, the following sampling frequencies are required by the Colbert Landfill Consent Decree:

- Within one week of receipt of laboratory results that indicate the Performance Standards were exceeded
- Monthly for 12 months following exceedance of 65 percent of the Table IV-1 Evaluation Criteria.

The following (additional) sampling frequencies are suggested by Landau Associates:

- Quarterly sampling near the downgradient leading edge of the plume, if constituent concentrations have previously been detected at levels below the Consent Decree sampling criteria
- Quarterly sampling in areas where contaminants are not migrating in the direction of ground water flow, constituent concentrations have previously been detected at levels below the Consent Decree sampling criteria, and constituent concentrations exceeding the Performance Standards were detected in nearby wells
- Quarterly sampling for multiple user wells where constituent concentrations were previously detected at levels below the Consent Decree sampling criteria
- Annual or semiannual sampling for wells with previously detected constituent concentrations below the Consent Decree sampling criteria, that do not meet the quarterly sampling criteria described above
- Annual sampling for wells without detectable concentrations of any of the Constituents of Concern that do not meet the criteria for biannual sampling or elimination from the Program
- Biannual sampling, or elimination from the Program, for those wells without detectable concentrations of the Constituents of Concern that meet the criteria for biannual sampling or Program elimination described in the Suggested Sampling Frequency Criteria section of this memorandum
- Discretionary sampling for follow-up to anomalous sampling results; the Sampling Committee's trigger criteria of 40 percent of the Table IV-1 Evaluation Criteria and a 25 percent increase over the previous sample results is an appropriate guideline, and 10 to 20 discretionary samples per annum should be adequate.

These suggested criteria were developed for wells presently in the Program. However, the criteria could also be applied when considering additions to the Program.

Some of the suggested sampling frequency criteria require knowledge of geohydrologic and contaminant transport concepts, and a thorough understanding of site-specific conditions.

At the County's discretion, a Landau Associates' representative will meet with the Sampling Committee to provide suggestions on a well-by-well basis. These suggestions would be advisory only; the decision on sampling frequency would be that of the Sampling Committee.

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The suggestions presented in this memorandum are based on Landau Associates' knowledge of geohydrologic conditions and contaminant distribution at the Colbert Landfill site, and our best engineering judgement. Contaminant migration is a dynamic and complex process and, as additional data become available, the sampling frequency criteria should be reviewed periodically and modified (if appropriate).

It should be recognized that no practical sampling frequency can ensure that individuals are not exposed to concentrations exceeding a given standard. However, the suggested sampling frequencies presented in this memorandum should provide adequate protection against chronic exposure to contaminant levels exceeding the health-based criteria established for the Colbert Landfill project.